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BRUSH

# D.C. PREAMPLIFIER
# MODEL 13 4185 25

## OPERATING INSTRUCTIONS

MP MASTER
MA34656

MANUAL PART NO.
13-804185-25

# D.C. PREAMPLIFIER
# MODEL 13 4185 25

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# TABLE OF CONTENTS


I GENERAL INFORMATION

1.1 Introduction . . . . . 1.1
1.2 Specifications . . . . . 1.2

II INSTALLATION

2.1 General . . . . . 2.1
2.2 Cabinet Installation . . . . . 2.1
2.3 Signal Connections . . . . . 2.1
2.4 Outline Dimensions . . . . . 2.1

III SERVICING

3.1 General . . . . . 3.1

IV OPERATION

4.1 General . . . . . 4.1
4.2 Front Panel Controls . . . . . 4.1

V CALIBRATION

5.1 General . . . . . 5.1
5.2 Calibration Procedures . . . . . 5.1

VI THEORY OF OPERATION

6.1 General . . . . . 6.1
6.2 Detailed Description . . . . . 6.1

VII TROUBLESHOOTING

7.1 General . . . . . 7.1
7.2 Fuses . . . . . 7.1
7.3 Troubleshooting Table . . . . . 7.1

VIII PARTS IDENTIFICATION

8.1 General . . . . . 8.1

# SECTION I

# GENERAL INFORMATION

## 1.1 INTRODUCTION

Brush eight-channel, direct current, Preamplifier, Model 13-4185-25 (Fig. 1-1) is designed for use with Brush multichannel recording systems. The preamplifier provides medium-gain amplification, where inputs are generally of similar character, as in telemetry, system test, or analog computer installations.

Seven sensitivity settings are provided for each channel on rotary-operated switches. Toggle switches, one for each channel, provide polarity reversal of the input signal.

The full-scale pen positioning and variable gain sensitivity controls are fitted with locking knobs to prevent inadvertent change after desired setting is selected.

Measurement range is 50 millivolts per chart division, to 250 volts full scale for each channel. Inputs are single-ended, floating, with 50 kilohm input impedance. Circuitry is solid-state with the power supply built in.

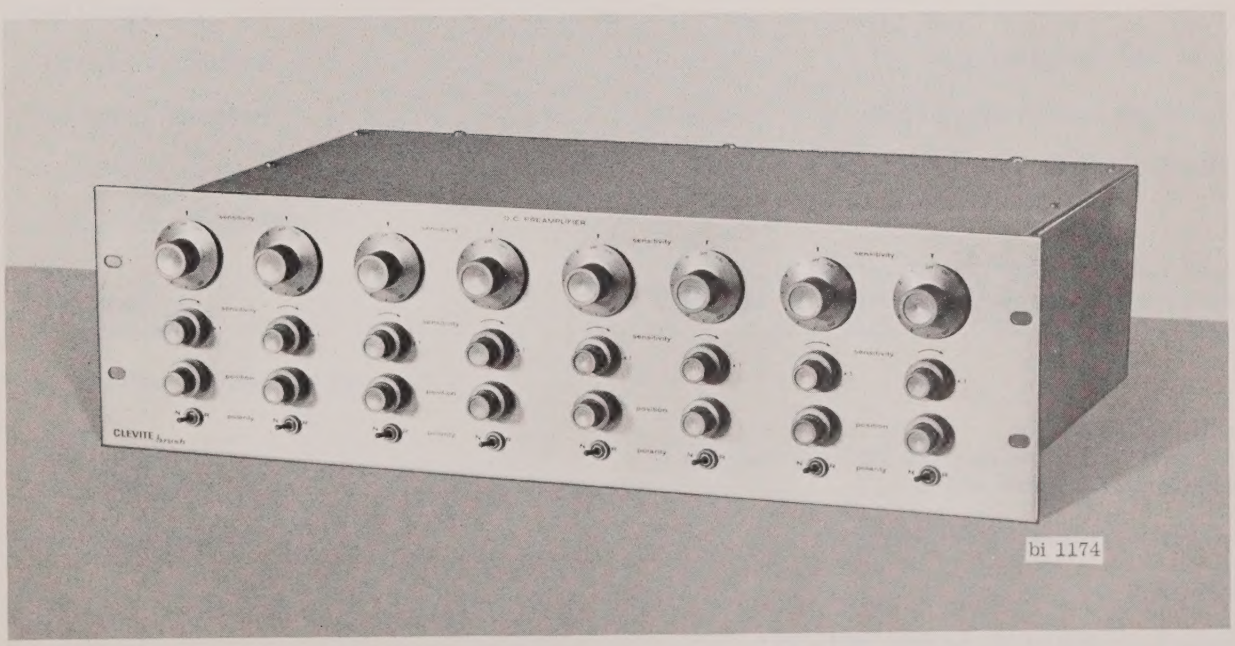



FIGURE 1-1 D.C. PREAMPLIFIER MODEL 13-4185-25

## 1.2 SPECIFICATIONS

The following specifications are pertinent to preamplifier, Model 13-4185-25, only --not entire system.

Signal Input

- Circuit . . . . . Single ended, floating
- Impedance . . . . . 50K ohm ±1% at all attenuator settings
- Sensitivity (Max) . . . . . .50 millivolts per division

Pen Position . . . . . .±75 divisions of d-c suppression minimum

Attenuator

- Steps . . . . . 0.05, 0.1, 0.2, 0.5, 1, 2, 5 volts per division, OFF and CAL
- Tolerance . . . . . ±0.5%
- Maximum Input Voltage . . . . . ±150 volts between input terminals; ±100 volts between input terminals and chassis

Internal Calibration

- Accuracy . . . . . ±0.2%
- Precision . . . . . ±0.1%

Signal Output

- To Drive Amplifiers . . . . . ±2.5 volts into 50K ohms
- Noise (on Recorder) . . . . . .0.1 division peak-to-peak, maximum
- Linearity . . . . . ±0.05% full scale

Zero Stability with Respect To

- Time . . . . . .0.1 division in 8 hours (after 60-second warm-up)
- Temperature . . . . . 0.05% per °C/±10°C from calibration temperature
- Line Voltage . . . . . .0.05 division for ±10% line voltage

Gain Stability with Respect To:

- Time . . . . . 0.1% per year
- Temperature . . . . . 0.02% per °C/±10°C from calibration temperature
- Line Voltage . . . . . 0.02% for ±10% line voltage

Frequency Response . . . . . No effect on drive amplifier response

Gain . . . . . .2.00 ±1%

Power Input . . . . . .115 ±10% volts a-c; 50 to 400 Hz; 4 watts

Power Supply . . . . . Self-contained

Environment

- Storage Temperature . . . . . .-40°F to +185°F

| | |
|---|---|
| Operating Temperature | +32°F to +131°F |
| Within Specs | ±10°F from temperature at calibration |
| Humidity | 95% at 90°F |
| Radio Noise Suppression | Per MIL-I-26600 Class 1 |

# SECTION II

# INSTALLATION

## 2.1 GENERAL

This section provides cabinet installation, signal connections and outline dimensions of the preamplifier.

## 2.2 CABINET INSTALLATION

Refer to drawing 666059.

## 2.3 SIGNAL CONNECTIONS

### a. AC Power

Connect preamplifier three leads to a 115 volt ±10% volt a-c; 50 to 400 Hz power source.

Green lead to Ground

White lead to Neutral

Black lead to Hot

### b. Signal Input (Connector J-3 on Main Connector Panel)

**NOTE: Connector P-3 (122109) mates with connector J-3 (121047). Also refer to schematic at rear of manual.**

Connect input signal as follows:

| Channel | Signal Lead To Pin | Common Lead To Pin |
|---|---|---|
| 1 | A | N |
| 2 | B | P |
| 3 | C | R |
| 4 | J | S |
| 5 | K | T |
| 6 | L | U |
| 7 | D | E |
| 8 | G | H |
| Shield | | M & F |

### c. Signal Output (1707 System)

Connect preamplifier output lead wire clusters to terminals 1 thru 4 of terminal boards TB-181, TB-182, TB-183, and TB-184 on rear of drive amplifier frame.

### d. Output Cable Color Coding (480 System)

| Channel | Signal | Common |
|---|---|---|
| 1 | Brown | White/Brown |
| 2 | Red | White/Red |
| 3 | Orange | White/Orange |
| 4 | Yellow | White/Yellow |
| 5 | Green | White/Green |
| 6 | Blue | White/Blue |
| 7 | Violet | White/Violet |
| 8 | Gray | White/Gray |
| Shield | | Black |

## 2.4 OUTLINE DIMENSIONS

Refer to Figure 2-1.

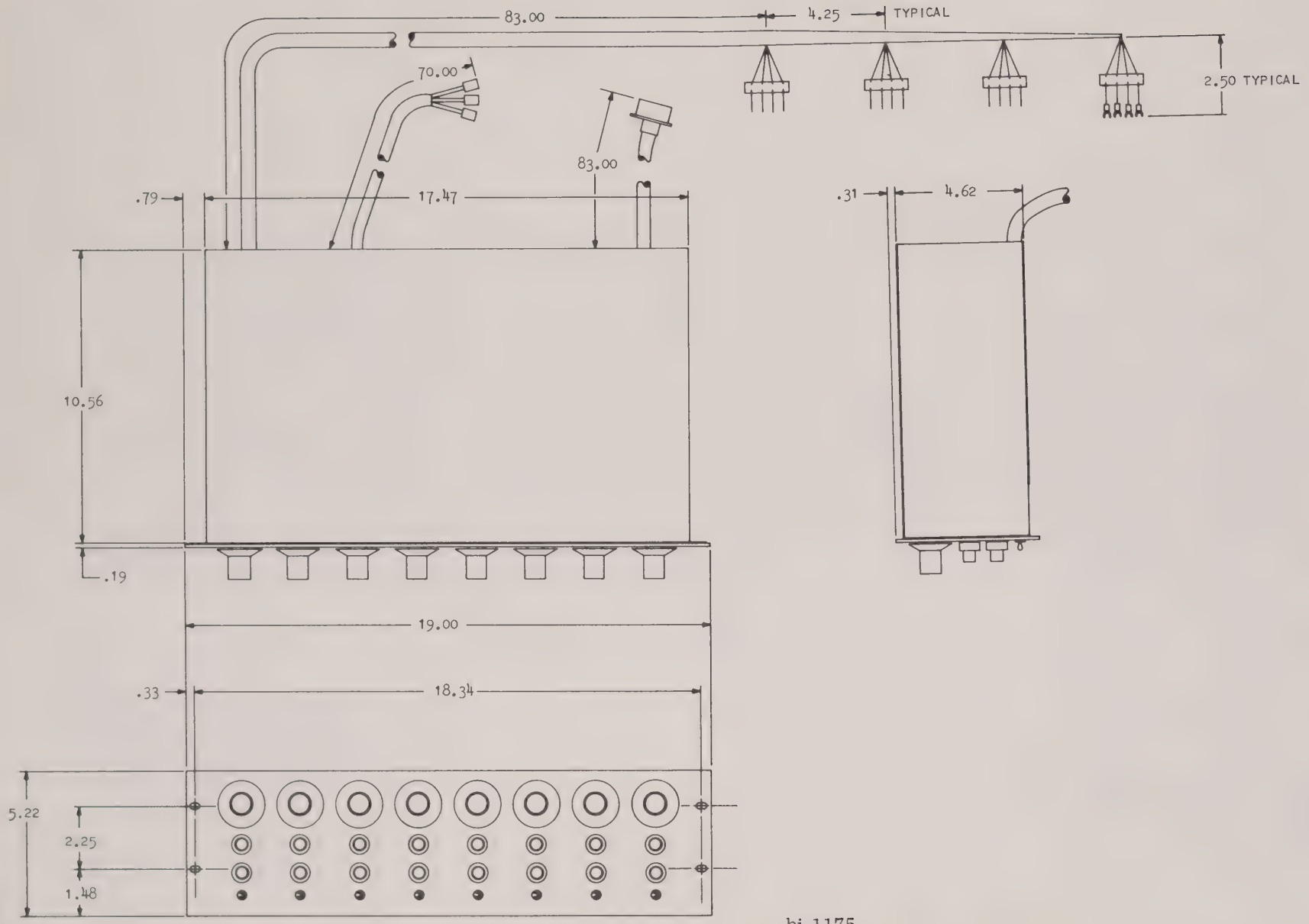
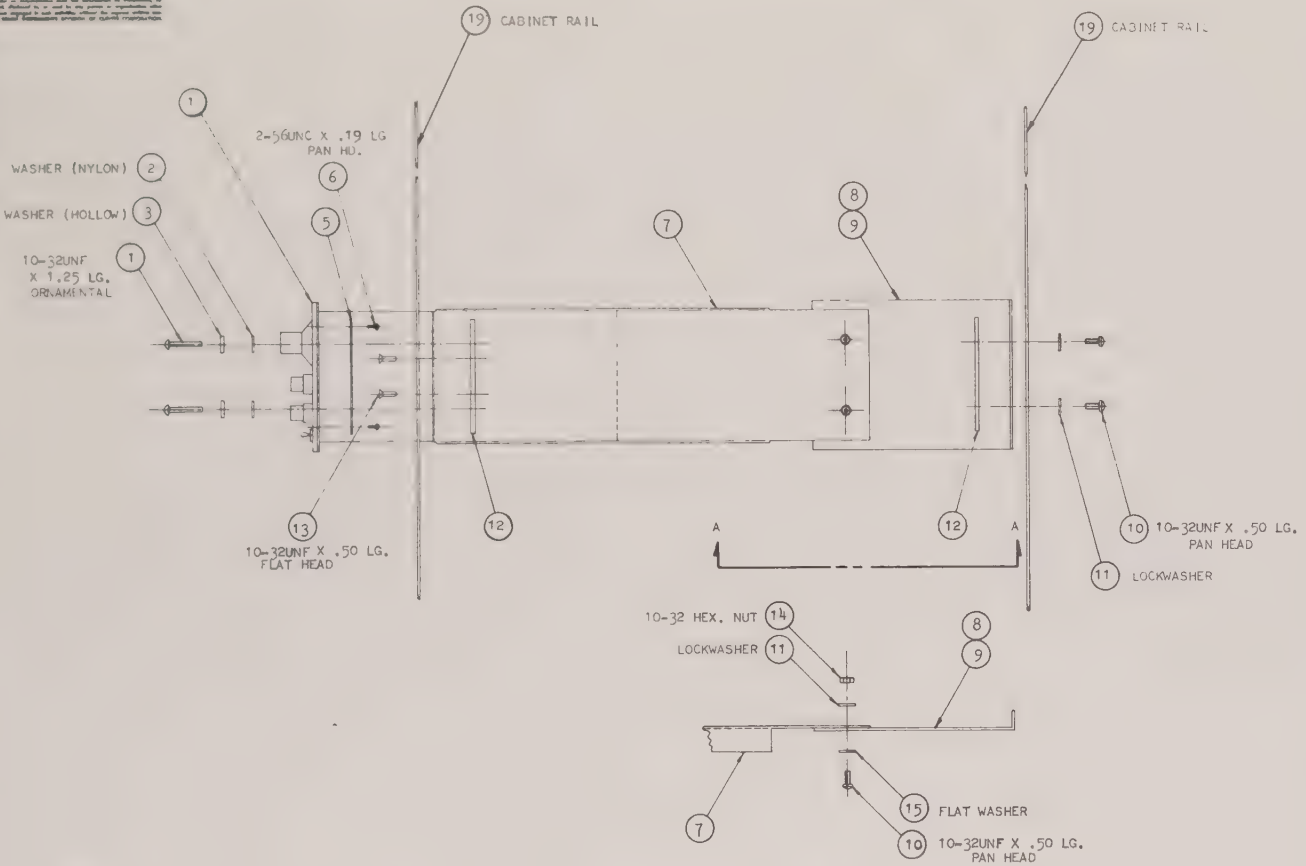



FIGURE 2-1 OUTLINE DIMENSIONS, MODEL 13-4185-25

REV A-1







VIEW A - A

NOTES:
1. NUMBERS IN CIRCLES INDICATE ITEM NUMBERS.
2. ASSEMBLE 5 TO 1, WITH 6, BOTH SIDES.
3. ASSEMBLE 7 AND 12 TO 19, WITH 13, BOTH SIDES.
4. ASSEMBLE 8, 9 AND 12, TO 19, WITH 10 AND 11.
5. ASSEMBLE 7, 8 AND 9, WITH 10, 11, 14 AND 15.
6. INSTALL 1 INTO 19, FASTENING IN PLACE WITH 2, 3 AND 4.

| NO. | BRUSH PART NO. | DESCRIPTION | QUAN |
|---|---|---|---|
| 30 | | | |
| 29 | | | |
| 28 | | | |
| 27 | | | |
| 26 | | | |
| 25 | | | |
| 24 | 422642 | ENVELOPE, MANUAL | 1 |
| 23 | 13-804185-05 | MANUAL, OPERATING | 1 |
| 22 | 222640 | CARD, CONCEALED DAMAGE | 1 |
| 21 | 431781 | CARTON, PACKING | 1 |
| 20 | 265456 | BAG, PLASTIC | 1 |
| 19 | CABINET | 19" RETMA | - |
| 18 | 118259-10 | BUSHING | 1 |
| 17 | 119993-112 | CLAMP, CABLE | 1 |
| 16 | 122109 | CONNECTOR | 1 |
| 15 | 1-118195-309 | WASHER | 4 |
| 14 | 31-119998-02 | NUT | 4 |
| 13 | 31-119920-0208 | SCREW, FLAT HEAD | 4 |
| 12 | 246200 | BAR, NUT | 4 |
| 11 | 1-216741-430 | LOCKWASHER | 8 |
| 10 | 31-119918-0208 | SCREW, PAN HEAD | 8 |
| 9 | 345982 | SLIDE, REAR - RT. HAND | 1 |
| 8 | 345983 | SLIDE, REAR - LEFT HAND | 1 |
| 7 | 449040 | SUPPORT | 2 |
| 6 | 31-119918-2603 | SCREW, PAN HEAD | 4 |
| 5 | 249562 | PLATE, SPACER | 2 |
| 4 | 31-121534-0220 | SCREW, ORNAMENTAL | 4 |
| 3 | 31-120650-10 | WASHER, CSK. | 4 |
| 2 | 126138-9 | WASHER, PLAIN | 4 |
| 1 | 13-4185-25 | PREAMPLIFIER ASM. | 1 |

SHIPPING LIST

| BY | DATE | NAME |
|---|---|---|
| WASTL | EH | SHIPPING LIST & INSTALLATION INSTRUCTIONS |

BRUSH INSTRUMENTS DIVISION OF GLEVITE CORP. CLEVELAND, OHIO, U.S.A.

DRAWING NO. 666059

CODE IDENT 96795 | ISSUE CODE G

# SECTION III

# SERVICING

## 3.1 GENERAL

Prior to the initial operation of the d-c preamplifier and at normal preventive-maintenance intervals, perform the following routine service procedures:

1. Check for proper operation of all controls.
2. Check that circuit boards are mounted properly.
3. Check to be sure all cable connectors are secure.
4. Be sure unit is free from dust or dirt.

# SECTION IV

# OPERATION

## 4.1 GENERAL

This section describes and illustrates the controls necessary for operating the solid-state preamplifier, Model 13-4185-25.

## 4.2 FRONT PANEL CONTROLS

**NOTE: The circled numbers in Figure 4-1 correspond with the items listed below.**

1 SENSITIVITY Control (Attenuator) . . . . . This control contains seven attenuation steps of 0.05, 0.1, 0.2, 0.5, 1, 2, and 5 volts per chart division, plus an OFF and CAL (Calibration) position. The CAL position is used to check gain of the amplifier system. When control is in CAL position, pen will deflect 25 divisions and return to zero signal position when control is moved from CAL position.

2 SENSITIVITY X1 Control . . . . . In the times one (detent) position, sensitivity is exactly as the control indicates. When the control is moved from the detent position, it allows selection of a sensitivity within the ranges of the SENSITIVITY control. A locking knob prevents inadvertent turning of the SENSITIVITY X1 control.

3 Pen POSITION Control . . . . . This control permits each pen to be positioned anywhere within the channel. A locking knob prevents inadvertent turning of the pen POSITION control.

4 POLARITY Reversing Switch . . . . . When the two-position toggle switch is placed in the N (normal) position a positive input to the amplifier results in a negative output. When the switch is placed in the R (reverse) position a positive input signal results in a positive output.

**NOTE: Reversing polarity will move the zero signal pen position. Rezero channel after reversing polarity.**

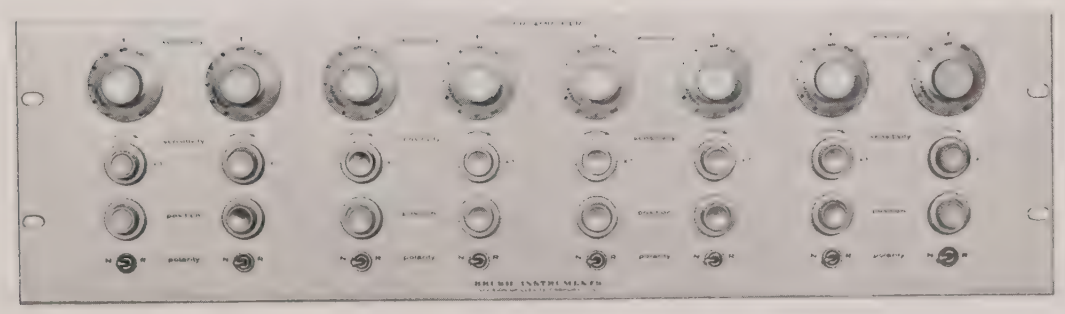


FIGURE 4-1 CONTROL DESCRIPTION

# SECTION V

# CALIBRATION

## 5.1 GENERAL

This section describes and illustrates the procedures for calibrating the preamplifier.

**NOTE: A Differential Voltmeter, John Fluke, Model 803B or equivalent and a Signal Generator, Hewlett-Packard, Model 202A or equivalent are required for calibration.**

## 5.2 CALIBRATION PROCEDURES

### a. General

No attempt should be made to calibrate unless the performance check, step b, verifies that the preamplifier is definitely out of calibration. If the stated requirements are not obtained, refer to steps c and d for detailed calibration procedures.

**NOTE: Procedures are provided for calibrating a single channel, repeat the procedures for each channel to be calibrated.**

### b. Performance Check

1. Turn on system power and allow 15 minutes for warm-up.
2. Turn all variable SENSITIVITY X1 controls to full clockwise (detent) position.
3. Place oscillograph into operation according to oscillograph manual.
4. Turn SENSITIVITY switches to CAL position. Each pen should deflect exactly 25 chart divisions.

**NOTE: If pens do not deflect exactly 25 chart divisions, refer to subparagraph c and d for detailed calibration procedures.**

5. The following input d-c signals should give 25 divisions deflection ±0.25 division at the attenuator settings indicated for each channel.

**NOTE: Refer to Paragraph 2.3b for connecting input signal.**

| DC Signal (Volts) | Attenuator Settings (Volts/Division) |
|---|---|
| +100.00 | 0.05 |
| + 50.00 | 0.1 |
| + 25.00 | 0.2 |
| + 10.00 | 0.5 |
| + 5.00 | 1.0 |
| + 2.50 | 2.0 |
| + 1.00 | 5.0 |

**NOTE: All voltages are measured with respect to common.**

### c. Balance Adjustment

**WARNING: CHECK TO BE SURE SYSTEM POWER SWITH IS OFF AND DISCONNECT POWER CABLE.**

1. Loosen four captive thumb screws on front of oscillograph and slide oscillograph out as far as possible.
2. Place a board (wood or composition) across top of oscillograph to act as a table for the preamplifier.
3. Remove preamplifier from cabinet (refer to drawing 666059, Section II) and place preamplifier on oscillograph.
4. Remove nine screws and remove preamplifier top cover.
5. Remove printed circuit board cover assembly.

**NOTE: Check to be sure all amplifier boards are properly installed.**

6. Turn on system power.
7. Use a signal generator and connect a 60 Hz signal with a 1-volt peak-to-peak amplitude to each channel at input connector J-3.
8. Turn SENSITIVITY control to OFF position.
9. Operate oscillograph at a chart speed of 20 millimeters per second.
10. Zero pens at chart center with the pen POSITION control.
11. Turn SENSITIVITY control to 0.05 volts/division position.
12. Adjust resistor R-103 on amplifier board (Fig. 5-1) until a-c signal displayed on chart is the same amplitude when the polarity switch is changed from normal (N) to reverse (R) position.

### d. Internal Calibration Voltage

1. Connect a differential voltmeter across contacts 1 and 2 of amplifier board (Fig. 5-1).
2. Turn SENSITIVITY control to CAL position.

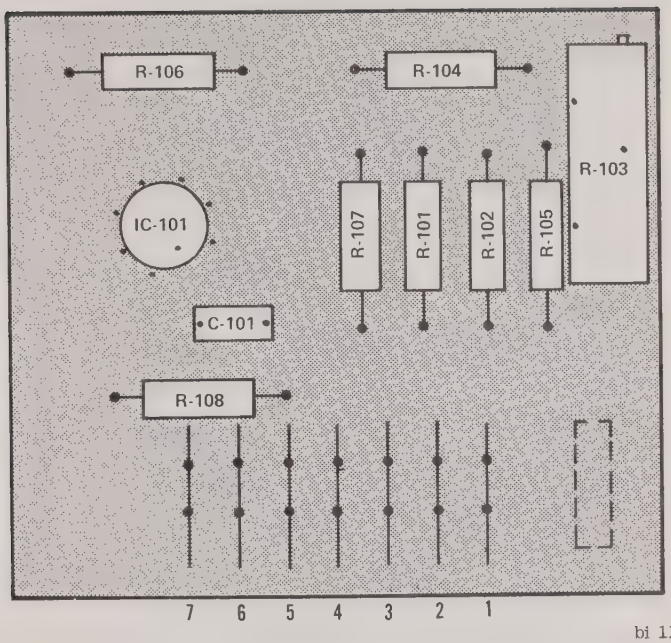



FIGURE 5-1 AMPLIFIER BOARD PLAN VIEW 765569

3. Adjust resistor R-207 on power supply board (Fig. 5-2) until voltage on meter reads 1.250 ±0.001 volt.

4. Check that pen on chart deflected 25 divisions. If not, refer to calibration section in system manual for channel gain adjustment.

5. Press oscillograph STOP button.

6. Disconnect differential voltmeter from amplifier board.

7. Disconnect signal generator from connector J-3.

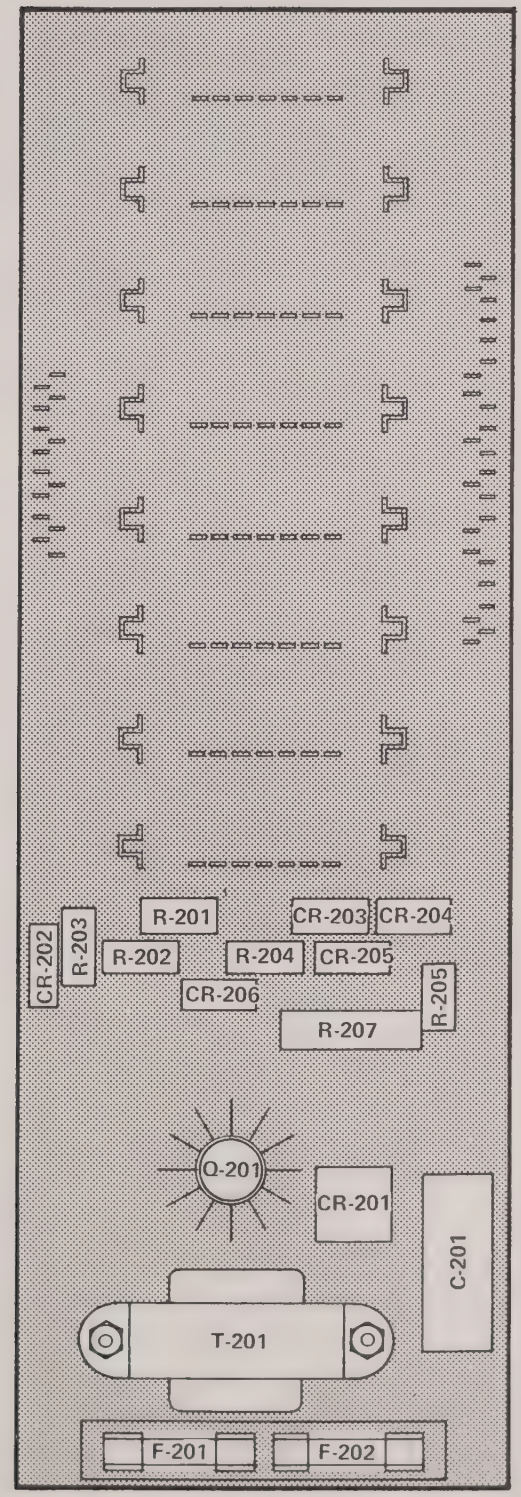
8. Turn off system power.

9. Install preamplifier printed circuit board cover.

10. Install preamplifier top cover using nine screws removed in step 4, subparagraph c.

11. Install preamplifier in cabinet (refer to drawing 666059, Section II).

12. Remove board from oscillograph, slide oscillograph into cabinet, and secure with four captive thumb screws.




bi 1177

FIGURE 5-2 POWER SUPPLY BOARD 865847

# SECTION VI

# THEORY OF OPERATION

## 6.1 GENERAL

Preamplifier, Model 13-4185-25 (Fig. 6-1) consists of eight plug-in differential operational amplifier assemblies mounted on a common power supply board. Attenuation of the input signal is accomplished by front panel controls, as is pen position and signal polarity.

The input signal is applied to the attenuator network (SENSITIVITY), POLARITY reversal switches and into the operational amplifier assemblies. A second input from the pen POSITION potentiometer biases the input signal. This allows the trace to be positioned arbitrarily on the chart grid.

The Operational Amplifier has two input signal connections. An inverting input and a non-inverting input. When the polarity reversal switch is in the N (normal) position the signal is coupled to the inverting input terminal. Therefore a positive input will produce a negative output. When the polarity reversal switch is in the R (reverse) position the input signal is coupled to the non-inverting input terminal. Therefore a positive input will produce a negative output.

## 6.2 DETAILED DESCRIPTION

### a. Power Supply (Fig. 6-2)

The power input is supplied by transformer T-201 thru rectifier CR-201 and a filter C-201 to a current regulator circuit comprised of diode CR-202, transistor Q-201, and resistors R-201 thru R-203. The current passed by transistor Q-201 drives the voltage regulator diodes CR-203 thru CR-206 to supply ±10 volts for the individual amplifier circuits.

Divider network, consisting of resistors R-204, R-205 and R-207, comprises the CAL (calibrate) voltage supply. Resistors R-206 and R-208 and transistor Q-202 provide regulated voltage for the identify circuitry and resistor R-209 provides a load on the negative (–) side of the voltage supply.

### b. Amplifier Board Assembly (Fig. 6-3)

Each amplifier board consists of a direct-coupled, differential amplifier with three inputs thru resistors R-101, R-102 and R-107. Normal gain is fixed by resistors R-101 and R-106. Reverse gain is varied and controlled by resistors R-102, R-105 and R-103. Resistor R-104 provides stability in the reverse mode and resistor R-108 controls offset.

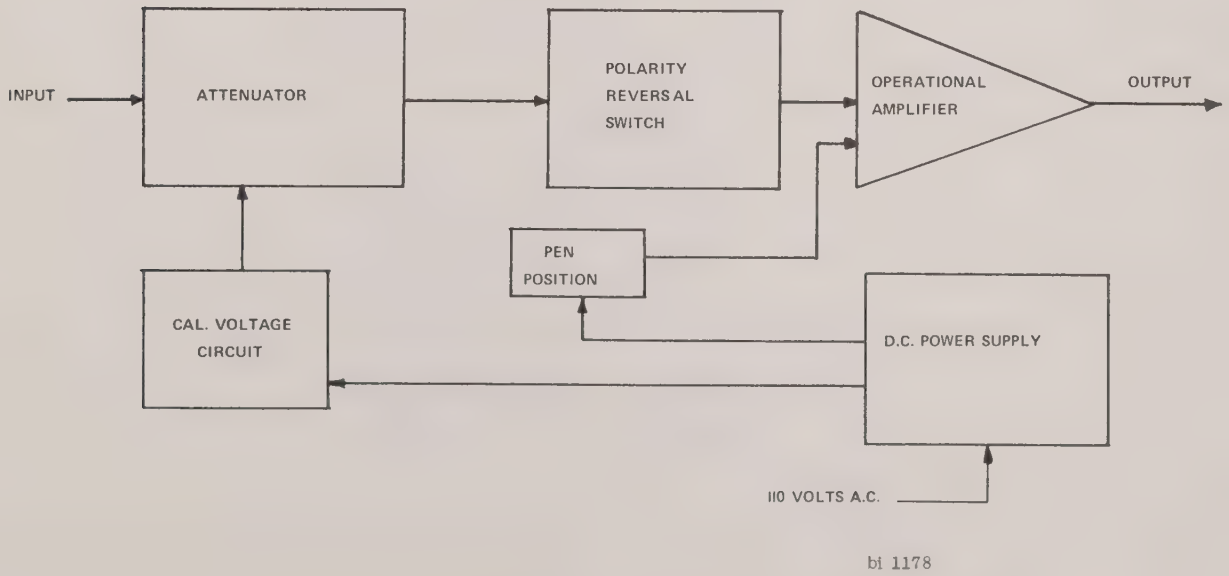



FIGURE 6-1 PREAMPLIFIER 13-4185-25 BLOCK DIAGRAM

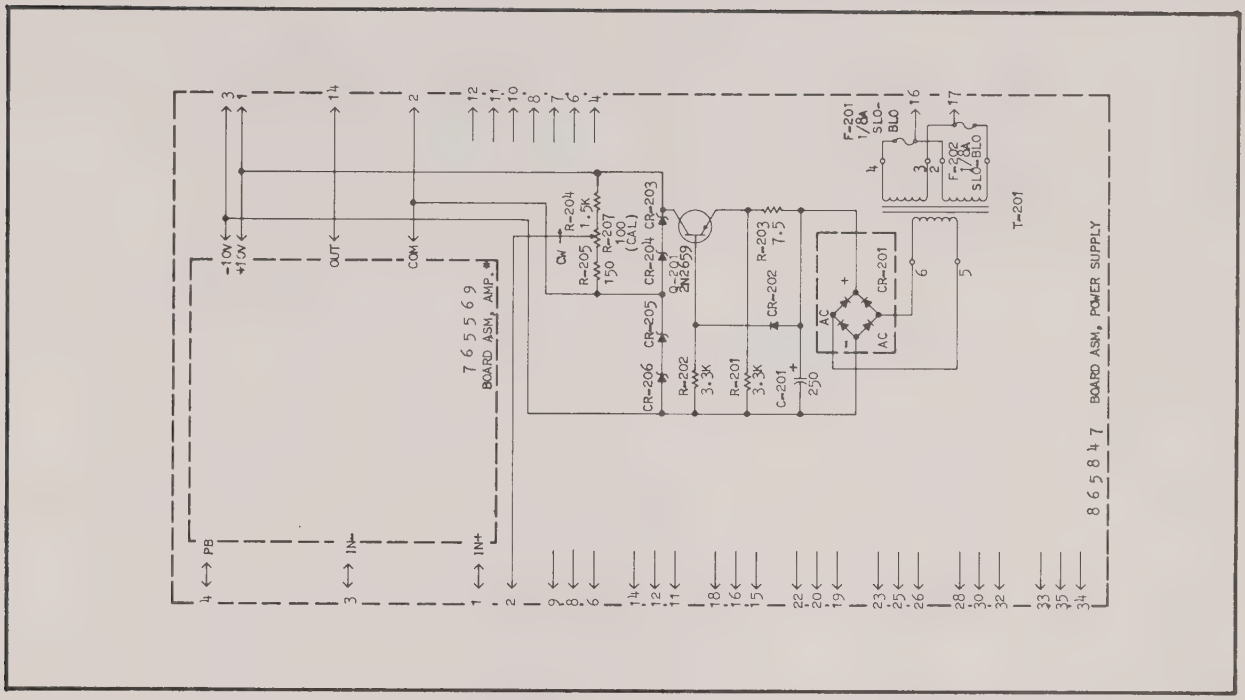



FIGURE 6-2 POWER SUPPLY BOARD ASM, CIRCUIT DIAGRAM

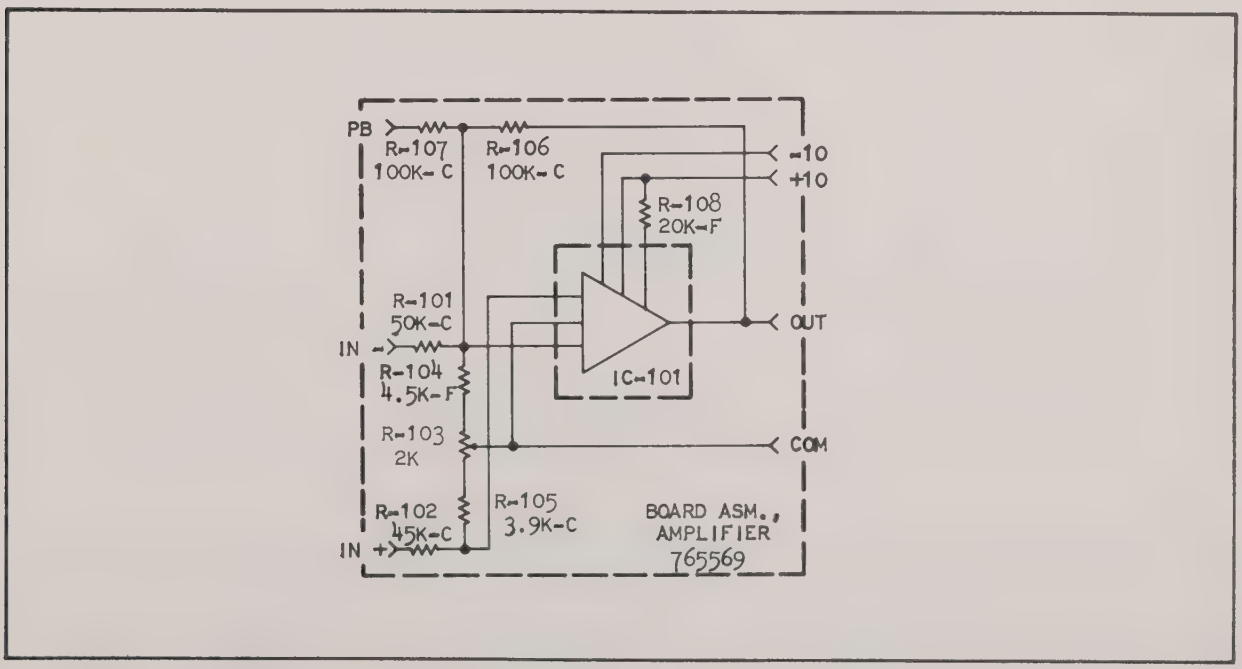



FIGURE 6-3 AMPLIFIER BOARD ASM, CIRCUIT DIAGRAM

# SECTION VII

# TROUBLESHOOTING

## 7.1 GENERAL

This section contains Troubleshooting Table 7-1 to assist operating personnel in isolating malfunctions that may occur during normal operation of the 13-4185-25 preamplifier. Any service required should be performed only by qualified service personnel or by a Brush service representative.

## 7.2 FUSES

When it is determined by visual inspection of the line fuses (F-801 and F-802) that one or both has failed, it is imperative that the operator determine the cause of a fuse failure before replacing it with another.

## 7.3 TROUBLESHOOTING TABLE

The troubleshooting Table 7-1 contains information which may be used by maintenance personnel to assist in isolating and correcting possible malfunctions that may occur in the preamplifier model 13-4185-25.

TABLE 7-1 TROUBLESHOOTING CHART

| MALFUNCTION | CAUSE | REMEDY |
|---|---|---|
| 1. Pen POSITION control will not make range (all channels) | a. Defective power supply assembly 865847 | a. Check and replace defective item |
| | b. Defective connector P-201 | b. Replace |
| 2. Pen POSITION control will not make range (not all channels) | a. Defective pen POSITION control R-709-R-716 | a. Replace |
| | b. Defective amplifier asm 765569 | b. Check and replace defective part |
| | c. Defective wiring | c. Replace |
| 3. Pens do not deflect when SENSITIVITY control is in CAL position | a. Defective switch S-501 | a. Check and replace defective switch asm component |
| | b. Defective power supply assembly 865847 | b. Check and replace defective components |
| 4. Pens deflect less than 25 divisions with SENSITIVITY control in CAL position (all channels) | Internal calibration voltage control R-207 improperly adjusted or defective | Adjust R-207 internal calibration voltage control or replace and adjust. Refer to internal calibration voltage, Section 5.2b. |
| 5. Pens deflect less than 25 division with SENSITIVITY control in CAL position (not all channels) | Applicable drive amplifier defective or improperly adjusted | Check and repair or replace defective component |
| 6. Pen does not deflect 25 divisions in opposite direction when POLARITY switch is moved from N (Normal) position to R (Reverse) position | a. Polarity switch S-709 wired improperly | a. Check wiring against drawing and rewire |
| | b. Polarity switch S-709 defective | b. Replace |
| | c. Connector P-201 defective | c. Replace |

| MALFUNCTION | CAUSE | REMEDY |
|---|---|---|
| 7. Pen deflection does not correspond to SENSITIVITY control setting (not all channels) | a. Defective drive amplifier | a. Check and repair or replace defective component |
| | b. Sensitivity switch defective S-501 | b. Replace |
| 8. Pen deflection does not correspond to SENSITIVITY control setting (all channels) | Defective power supply assembly 865847 | Check and repair or replace defective component |

# SECTION VIII

# PARTS IDENTIFICATION

## 8.1 GENERAL

This unit has been accurately calibrated and adjusted before shipment from the factory and should give long, trouble-free service. For servicing beyond the scope of the instructions contained in this manual or the technical equipment available, contact your nearest Brush Service Engineer listed on the warranty card shipped with the unit.

The following parts lists and schematic diagrams are designed to assist in servicing and repairing the unit.

**NOTE: Check to be sure the schematic number and revision letter stamped on the rear of the recorder agree with the number and revision letter on the schematic contained in this section.**

To assure prompt and satisfactory delivery of replacement parts, include the following with the purchase order:

1. Name, model number, and serial number of the instrument

   For example: Brush D.C. Preamplifier Model 13-4185-25, Serial Number _____.

2. Description of the part as listed in the manual.

3. Brush part number.

**NOTE: Do not use the SYMBOL NUMBER from the parts list for identifying desired parts on the order.**

EXPLODED VIEW PARTS LIST
PREAMPLIFIER MODEL 13-4185-25 (Figure 8-1)

| ITEM NO | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 866016 | Front Panel Asm (see Fig. 8-2) |
| 2 | 466025 | Bracket Chassis, Support |
| 3 | 466027 | Cover, Top |
| 4 | 666006 | Power Cable |
| 5 | 108572-11 | Bushing |
| 6 | 243192 | Ident Plate |
| 7 | 1-128693-2 | Grommet |
| 8 | 265814-3 | Terminal Board |
| 9 | 765702 | Cover Asm |
| 10 | 866008 | Cable Asm |
| 11 | 765569 | Amplifier Board Asm (see Fig. 8-4) |
| 12 | 865847 | Power Supply Board Asm (see Fig. 8-5) |
| 13 | 865994 | Harness |
| 14 | 232660-8 | Clamp, Loop |
| 15 | 866028 | Chassis Subasm |
| 16 | 124804-2 | Clamp, Cable |
| 17 | 232660-7 | Clamp, Loop |
| 18 | 122109 | Connector |
| 19 | 865978 | Harness Asm |

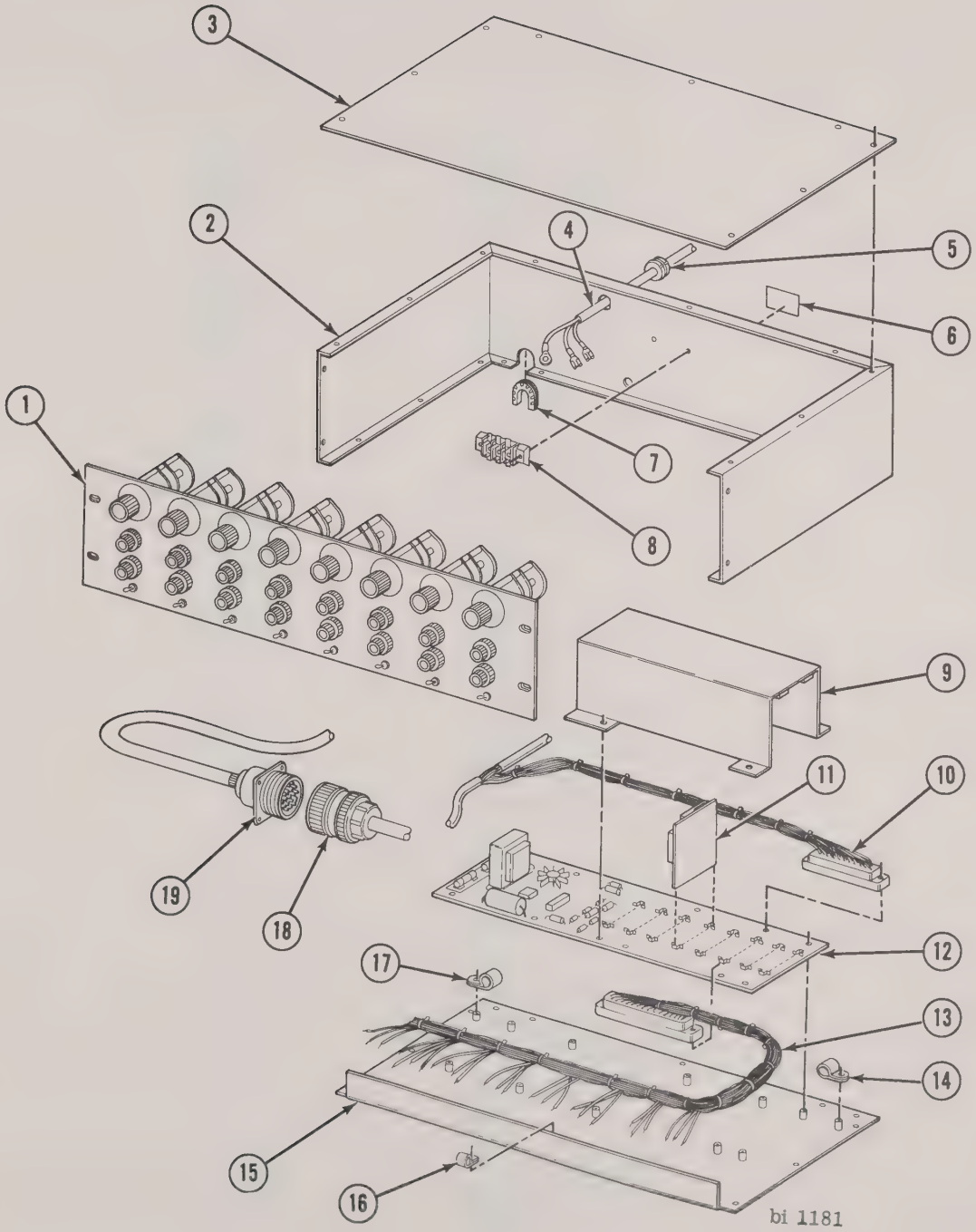



FIGURE 8-1 D.C. PREAMPLIFIER MODEL 13-4185-25

EXPLODED VIEW PARTS LIST
PREAMPLIFIER MODEL 13-4185-25
FRONT PANEL ASSEMBLY 866016 (Figure 8-2)

| ITEM NO | PART NUMBER | DESCRIPTION | SYMBOL NO |
|---|---|---|---|
| 1 | 848789 | Front Panel | |
| 2 | 248752-1 | Switch, DPDT | S-716 |
| 3 | 240093 | Nut, Plain Knurled | |
| 4 | 248752-1 | Switch, DPDT | S-715 |
| 5 | 240093 | Nut, Plain Knurled | |
| 6 | 248752-1 | Switch, DPDT | S-714 |
| 7 | 240093 | Nut, Plain Knurled | |
| 8 | 246054 | Resistor, Variable | R-713 |
| 9 | 248752-1 | Switch, DPDT | S-713 |
| 10 | 240093 | Nut, Plain Knurled | |
| 11 | 648803 | Knob Assembly | |
| 12 | 231183 | Knob | |
| 13 | 231182 | Nut, Self Locking | |
| 14 | 231183 | Knob | |
| 15 | 231182 | Nut, Self Locking | |
| 16 | 231183 | Knob | |
| 17 | 231182 | Nut, Self Locking | |
| 18 | 231183 | Knob | |
| 19 | 231182 | Nut, Self Locking | |
| 20 | 231183 | Knob | |
| 21 | 231182 | Nut, Self Locking | |
| 22 | 231183 | Knob | |
| 23 | 231182 | Nut, Self Locking | |
| 24 | 231183 | Knob | |
| 25 | 231182 | Nut, Self Locking | |
| 26 | 231183 | Knob | |
| 27 | 231182 | Nut, Self Locking | |
| 28 | 231183 | Knob | |
| 29 | 231182 | Nut, Self Locking | |
| 30 | 231183 | Knob | |
| 31 | 231182 | Nut, Self Locking | |
| 32 | 231183 | Knob | |
| 33 | 231182 | Nut, Self Locking | |
| 34 | 231183 | Knob | |
| 35 | 231182 | Nut, Self Locking | |
| 36 | 231183 | Knob | |
| 37 | 231182 | Nut, Self Locking | |
| 38 | 231183 | Knob | |
| 39 | 231182 | Nut, Self Locking | |
| 40 | 231183 | Knob | |
| 41 | 231182 | Nut, Self Locking | |
| 42 | 231183 | Knob | |
| 43 | 231182 | Nut, Self Locking | |
| 44 | 648803 | Knob Asm | |
| 45 | 648803 | Knob Asm | |

EXPLODED VIEW PARTS LIST (Continued)
PREAMPLIFIER MODEL 13-4185-25
FRONT PANEL ASSEMBLY 866016 (Figure 8-2)

| ITEM NO | PART NUMBER | DESCRIPTION | SYMBOL NO |
|---|---|---|---|
| 46 | 648803 | Knob Asm | |
| 47 | 648803 | Knob Asm | |
| 48 | 648803 | Knob Asm | |
| 49 | 246054 | Resistor, Variable | R-709 |
| 50 | 247236 | Resistor, Variable | R-701 |
| 51 | 848811 | Switch Asm (see Fig. 8-3) | |
| 52 | 848828 | Mounting Bracket Asm | |
| 53 | 248752-1 | Switch, DPDT | S-709 |
| 54 | 240093 | Nut, Plain Knurled | |
| 55 | 848811 | Switch Asm (see Fig. 8-3) | |
| 56 | 247236 | Resistor, Variable | R-702 |
| 57 | 246054 | Resistor, Variable | R-710 |
| 58 | 248752-1 | Switch, DPDT | S-710 |
| 59 | 240093 | Nut, Plain Knurled | |
| 60 | 848811 | Switch Asm (see Fig. 8-3) | |
| 61 | 247236 | Resistor, Variable | R-703 |
| 62 | 648803 | Knob Asm | |
| 63 | 848811 | Switch Asm (see Fig. 8-3) | |
| 64 | 246054 | Resistor, Variable | R-711 |
| 65 | 247236 | Resistor, Variable | R-704 |
| 66 | 248752-1 | Switch, DPDT | S-711 |
| 67 | 240093 | Nut, Plain Knurled | |
| 68 | 848811 | Switch Asm (see Fig. 8-3) | |
| 69 | 246054 | Resistor, Variable | R-712 |
| 70 | 848811 | Switch Asm (see Fig. 8-3) | |
| 71 | 248236 | Resistor, Variable | R-705 |
| 72 | 648803 | Knob Asm | |
| 73 | 248752-1 | Switch, DPDT | S-712 |
| 74 | 240093 | Nut, Plain Knurled | |
| 75 | 848811 | Switch Asm (see Fig. 8-3) | |
| 76 | 247236 | Resistor, Variable | R-706 |
| 77 | 848811 | Switch Asm (see Fig. 8-3) | |
| 78 | 247236 | Resistor, Variable | R-707 |
| 79 | 246054 | Resistor, Variable | R-714 |
| 80 | 247236 | Resistor, Variable | R-708 |
| 81 | 246054 | Resistor, Variable | R-715 |
| 82 | 246054 | Resistor, Variable | R-716 |

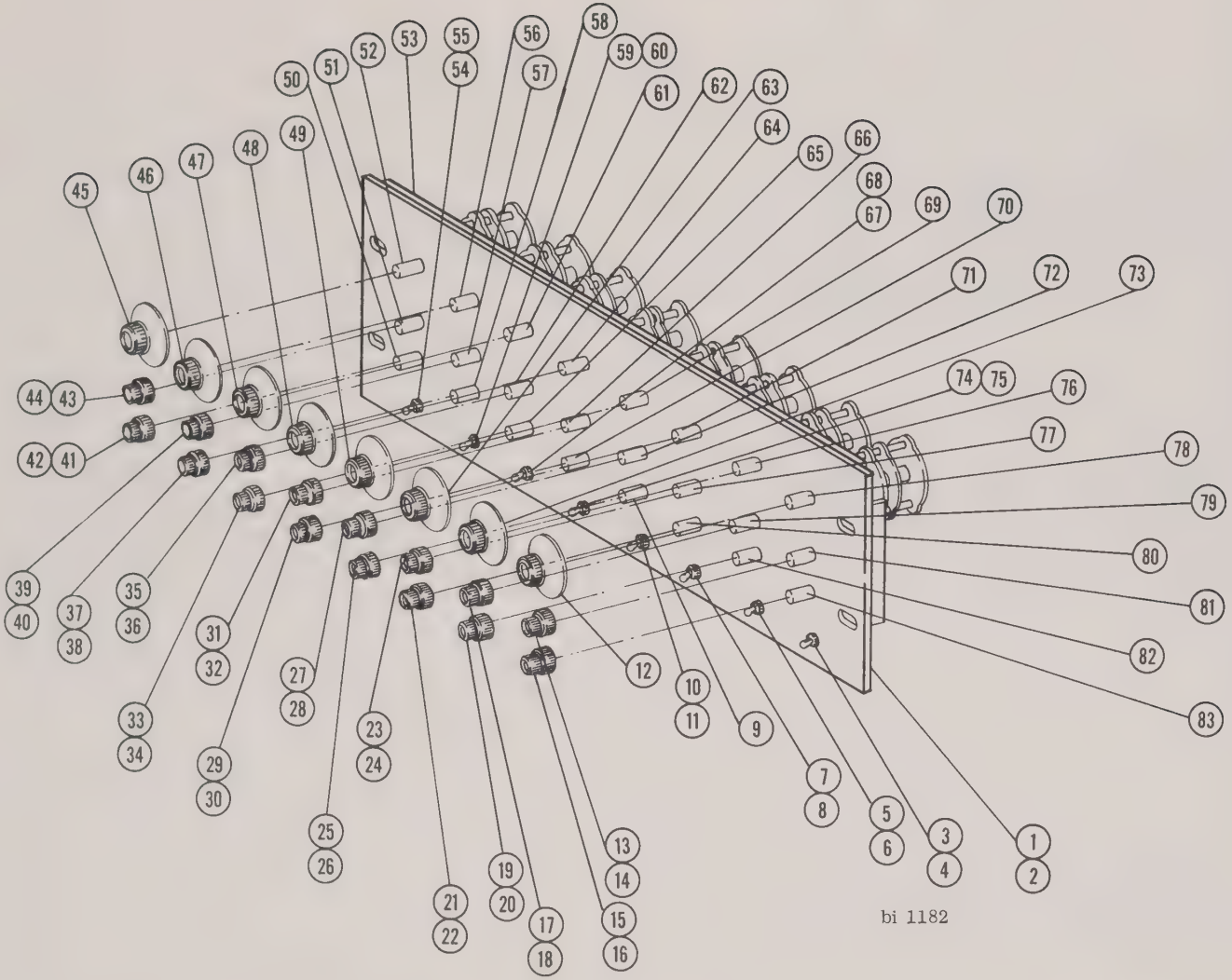
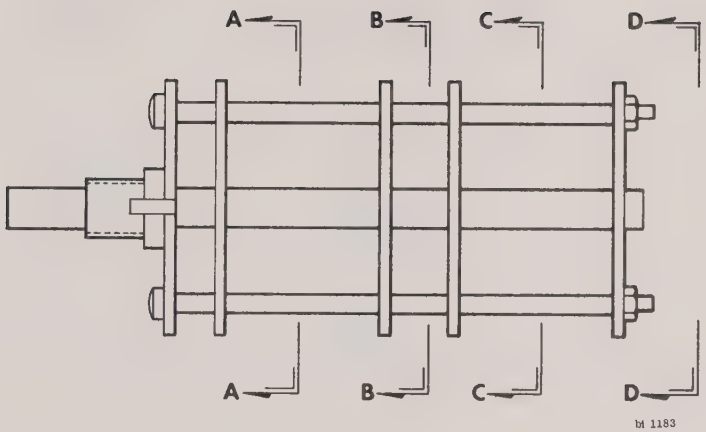


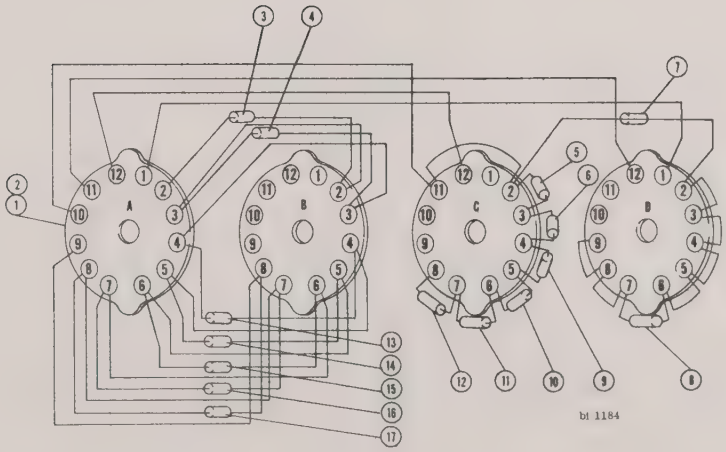

FIGURE 8-2 PREAMPLIFIER 13-4185-25, FRONT PANEL ASSEMBLY 866016

EXPLODED VIEW PARTS LIST
PREAMPLIFIER MODEL 13-4185-25
SWITCH ASSEMBLY 848811 (Figure 8-3)

| ITEM NO | PART NUMBER | DESCRIPTION | SYMBOL NO |
|---|---|---|---|
| 1 | 347152 | Switch, Rotary | S-501 |
| 2 | 5-115557-471 | Resistor | R-507 |
| 3 | 25-240368-750R0 | Resistor | R-508 |
| 4 | 25-240368-508R0 | Resistor | R-501 |
| 5 | 25-240368-778R0 | Resistor | R-502 |
| 6 | 1-128182-5002 | Resistor | R-514 |
| 7 | 9-123685-2 | Insulation | |
| 8 | 25-240368-13500 | Resistor | R-503 |
| 9 | 25-240368-29200 | Resistor | R-504 |
| 10 | 25-240368-11111 | Resistor | R-505 |
| 11 | 25-240368-33331 | Resistor | R-505 |
| 12 | 25-240368-12500 | Resistor | R-509 |
| 13 | 25-240368-25000 | Resistor | R-510 |
| 14 | 25-240368-75000 | Resistor | R-511 |
| 15 | 25-240368-12501 | Resistor | R-512 |
| 16 | 25-240368-25001 | Resistor | R-513 |




A - SENSITIVITY SWITCH 347152




B - SENSITIVITY SWITCH WITH COMPONENTS

FIGURE 8-5 SENSITIVITY SWITCH 848811

## ELECTRICAL PARTS LIST
## AMPLIFIER BOARD ASSEMBLY 765569 (Figure 8-4)

| SYMBOL NO | PART NUMBER | DESCRIPTION |
|---|---|---|
| IC-101 | 668839 | Integrated Circuit |
| | (consists of) | |
| | 240352-5R0 | Capacitor |
| | 230062 | Semiconductor |
| R-101 | 25-240368-50001 | Resistor |
| R-102 | 25-240368-45001 | Resistor |
| R-103 | 268940-202 | Resistor, Variable |
| R-104 | 1-128182-4501 | Resistor |
| R-105 | 1-128182-3901 | Resistor |
| R-106 | 25-240368-10002 | Resistor |
| R-107 | 25-240368-10002 | Resistor |
| R-108 | 1-128182-2002 | Resistor |

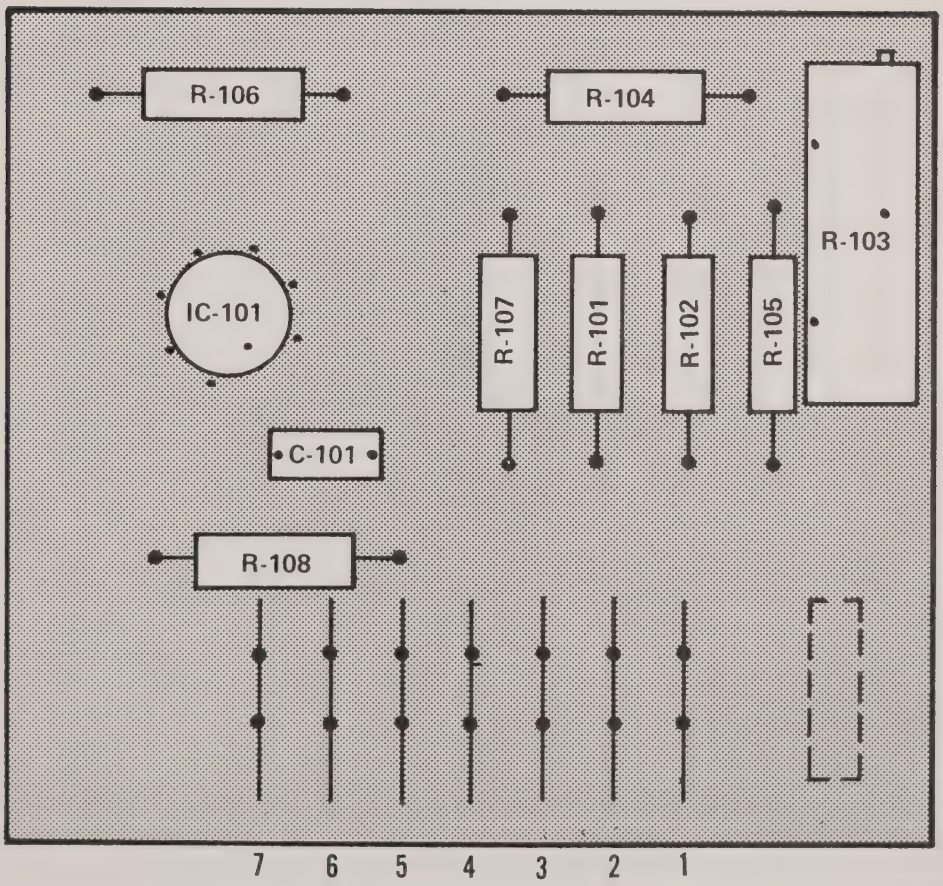



FIGURE 8-4 PREAMPLIFIER 13-4185-25, AMPLIFIER BOARD ASSEMBLY 765569

ELECTRICAL PARTS LIST
POWER SUPPLY BOARD ASSEMBLY 865847 (Figure 8-5)

| SYMBOL NO | PART NUMBER | DESCRIPTION |
|---|---|---|
| | 865641 | Board, P.C. |
| C-201 | 243037-257 | Capacitor |
| CR-201 | 265420-1 | Semiconductor |
| CR-202 | 231869 | Diode 1N816 |
| CR-203 | 241133 | Diode, Zener |
| CR-204 | 241133 | Diode, Zener |
| CR-205 | 241133 | Diode, Zener |
| CR-206 | 241133 | Diode, Zener |
| F-201 | 116198-4 | Fuse |
| F-202 | 116198-4 | Fuse |
| Q-201 | 262454 | Transistor 2N2659 |
| R-201 | 5-115557-332 | Resistor |
| R-202 | 5-115557-332 | Resistor |
| R-203 | 5-115557-7R5 | Resistor |
| R-204 | 5-115557-152 | Resistor |
| R-205 | 5-115557-151 | Resistor |
| R-207 | 20-231373-101 | Resistor, Variable |
| T-201 | 265531 | Transformer, Power |

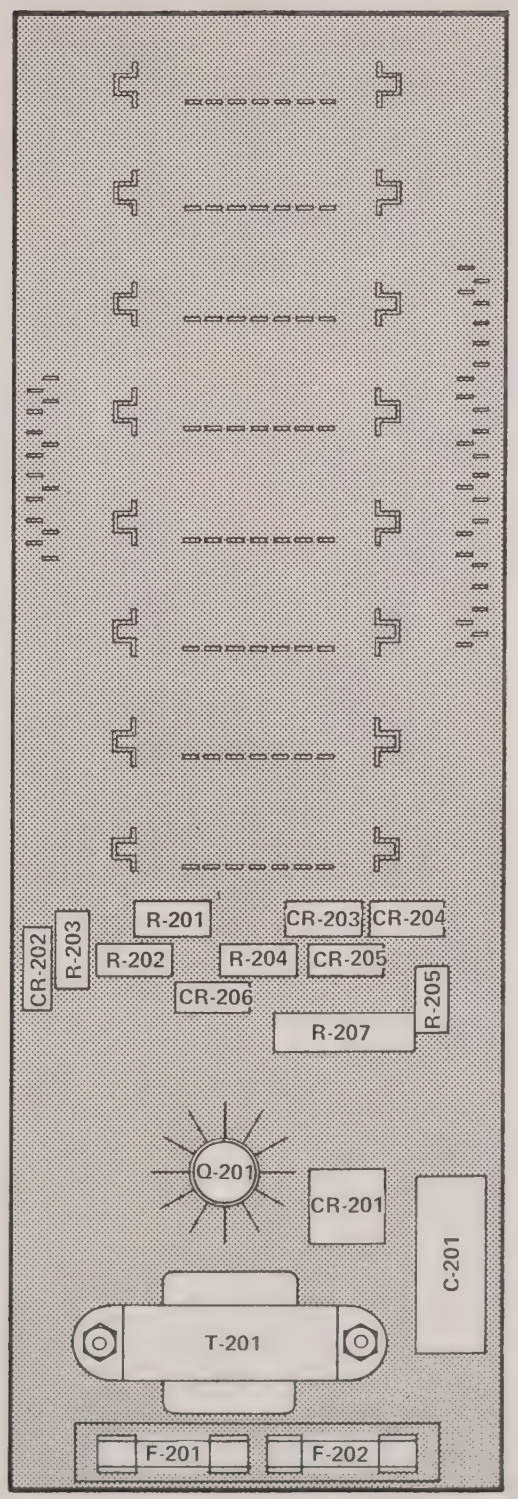
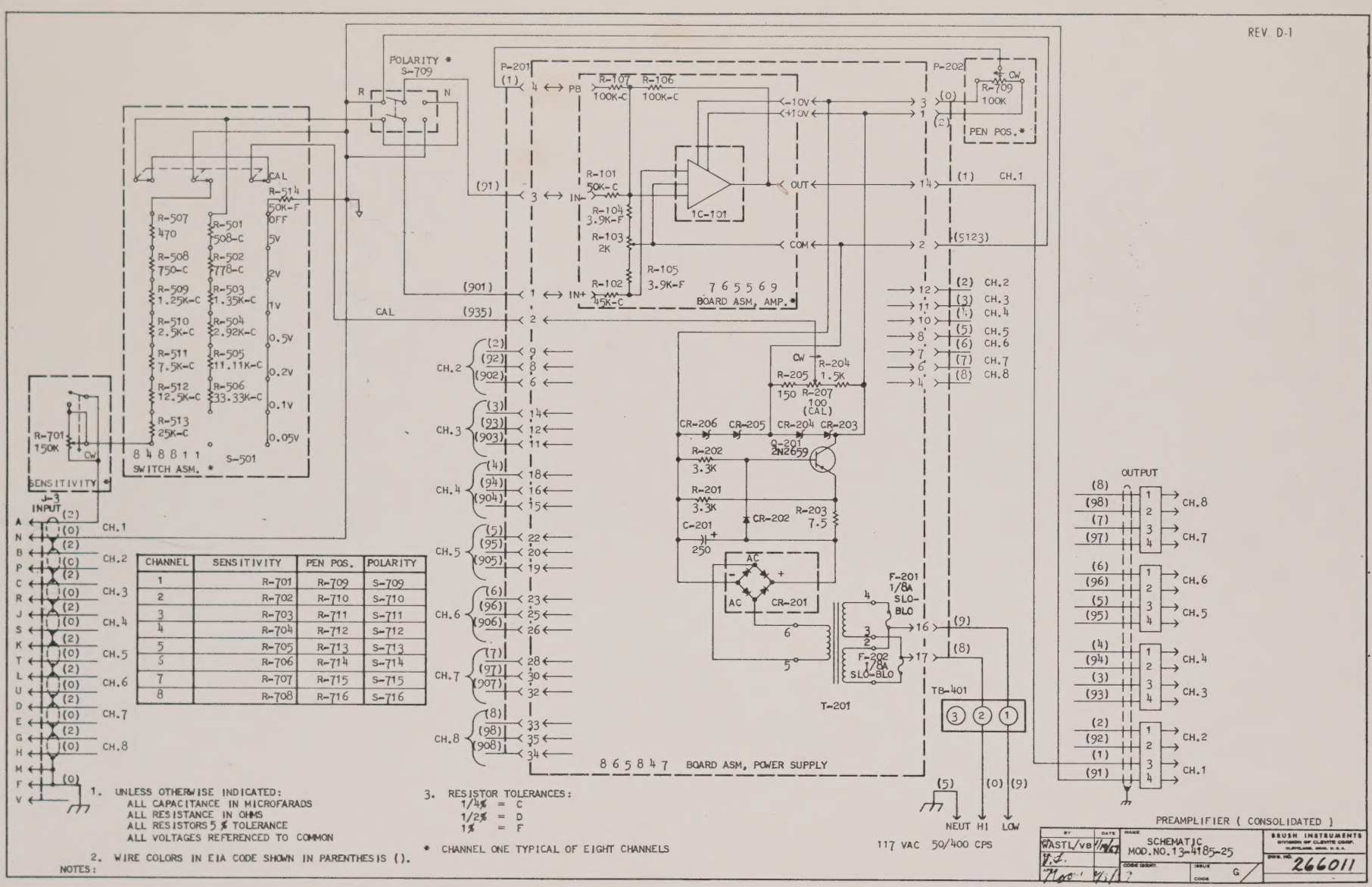



FIGURE 8-5 PREAMPLIFIER 13-4185-25, POWER SUPPLY BOARD ASSEMBLY 865847

REV. D-1




| CHANNEL | SENSITIVITY | PEN POS. | POLARITY |
|---|---|---|---|
| 1 | R-701 | R-709 | S-709 |
| 2 | R-702 | R-710 | S-710 |
| 3 | R-703 | R-711 | S-711 |
| 4 | R-704 | R-712 | S-712 |
| 5 | R-705 | R-713 | S-713 |
| 6 | R-706 | R-714 | S-714 |
| 7 | R-707 | R-715 | S-715 |
| 8 | R-708 | R-716 | S-716 |

NOTES:

1. UNLESS OTHERWISE INDICATED:
   ALL CAPACITANCE IN MICROFARADS
   ALL RESISTANCE IN OHMS
   ALL RESISTORS 5 % TOLERANCE
   ALL VOLTAGES REFERENCED TO COMMON

2. WIRE COLORS IN EIA CODE SHOWN IN PARENTHESIS ().

3. RESISTOR TOLERANCES:
   1/4% = C
   1/2% = D
   1% = F

* CHANNEL ONE TYPICAL OF EIGHT CHANNELS

PREAMPLIFIER ( CONSOLIDATED )

| BY | DATE | NAME |
|---|---|---|
| WASTL/VB | 1/67 | SCHEMATIC MOD. NO. 13-4185-25 |
| F.L. | | |
| Moe Wilf | | |

BRUSH INSTRUMENTS DIVISION OF CLEVITE CORP. CLEVELAND, OHIO, U.S.A.

DWG. NO. 266011

CODE IDENT. ISSUE CODE G

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MA34656

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